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PERSONAL VIEW

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What's in a name? Research learning outcomes in primary medical education

Colleen Cheek[1,2], Richard Hays[3] & Janie Smith[2]

[1]Education and Research, Tasmania Health Service North West, Australia; [2]Faculty of Health Sciences and Medicine, Bond University, Australia; [3]Centre for Rural & Remote Health, James Cook University, Australia

I. INTRODUCTION

Research ability is considered important in preparing medical graduates for their future work roles, providing openness to critical inquiry and astute information management (Frenk et al., 2010). The role of knowledge integrator, facilitator, and advisor, incorporating finely-tuned judgement, reasoning and decision-making, are important in achieving the leadership expected of the profession (Frenk et al., 2010). Engaging medical students in research training has historically proven challenging, and there is variable understanding of the level expected in primary medical training.

Most medical schools in Australia have now adopted a Master's Level 'Medical Doctorate' (MD) for primary medical training. Both the Australian Qualifications Framework (2013) requirements (pertaining to the level of qualification) and the Australian Medical Council (AMC) standards (pertaining to the profession) expect graduates of an MD to have understanding of research principles, process and methods, and to be able to apply these to professional practice (Australian Medical Council Limited, 2012). Many schools have interpreted this as a requirement for more intensive research training. While research knowledge and skills are integrated throughout curricula, there is substantial variation in the way these are taught, and little evidence of effective learning exists.

Varying approaches to align courses internationally may have muddied the situation further. For example, in the UK, primary medical training is considered to meet the requirements of a UK Level 7 Master's Degree, although most programmes have retained historical titles of Bachelor of Medicine, Bachelor of Surgery, abbreviated as BM BS or MBChB. In Canada, graduates of primary medical training are awarded the degree of Doctor of Medicine (MD) but are considered to have achieved academic outcomes at Bachelor level. In the US, graduates of primary medical training are awarded the degree of Doctor of Medicine (MD) and widely assumed to achieve Master's level learning outcomes. European medical schools, through conformance with the Bologna Declaration, are tending toward a 2nd cycle, or Master's degree. In the Asia-Pacific region, Singapore retains a Bachelor of Medicine, Bachelor of Surgery (MBBS), as do Malaysia (a Level 6 Bachelor degree), Japan and New Zealand. In Australia, there are some Bachelor (Level 7) programmes but most medical schools have adopted a Master's Degree (Extended) (Level 9E) for primary medical training, conferring a 'Medical Doctorate' (MD). In these examples there is little correlation between learning outcome levels and programme duration, which ranges from four to six years.

A. Defining Learning Outcomes and the Level of Understanding Required

The most recent standards of the World Federation for Medical Education promote 'constructively aligned' medical education. That is, teaching activities and assessment aligned with student-centred learning outcomes where the type of knowledge, whether declarative (book knowledge) or functional (professional

know-how required in the workplace), and the level of understanding required are clear.

The level of understanding can be mapped from taxonomies of action verbs. The Structure of Observed Learning Outcomes (SOLO) is one taxonomy (Biggs & Collis, 2014). It consists of five levels of understanding that reflect increasing learning complexity. The first is pre-structural (no understanding); through uni-structural and multi-structural (representing two stages of qualitative comprehension) to relational and extended abstract. The verbs 'order' and 'compute' might describe learning action at uni- and multi-structural stages, whereas 'construct' and 'extrapolate' describe learning action at relational and extended abstract stages. Once learning outcomes are explicit, decisions about teaching activities that will allow the student to achieve the learning outcomes can be made. For example, functional knowledge verbs e.g. 'assess' or 'reflect', reflects activity performed in the workplace (ideally), or an authentic simulated environment.

Here we provide a perspective of the research knowledge and skills required of graduates of an Australian MD to promote shared understanding of the level of learning and the key elements for orientating teaching to medical practice.

II. METHODS

To define the Individual Learning Outcomes (ILO) relating to research competency in Australia, the Level 9E Australian Qualifications Framework (AQF) criteria and descriptors (Australian Qualifications Framework, 2013) and the AMC standards and graduate outcomes (Australian Medical Council Limited, 2012) that pertained to research knowledge and skills were collated (Appendix 1). Using the SOLO taxonomy (Biggs & Collis, 2014), the types of knowledge and the required level of understanding was determined (Appendix 2).

III. RESULTS

Three issues emerged. The first was that the highest levels of understanding required (extended abstract), pertain to functional knowledge such as critically analysing information, reflecting on and applying theory. Graduates are expected to have 'expert' knowledge and abilities in this area based on 'research, experience or occupation'. This may imply that achieving the higher-level learning outcomes requires a substantial research experience, such as a completed project that engages students in all aspects of planning, conducting, and reporting research. This reflects what happens during the AQF Level 10 (doctoral level) research training and may be difficult to achieve during a Level 9E programme.

The second was that a high level of functional knowledge (relational) is required to plan and execute project work, reflecting the more traditional, Master's (Research) programme. This should be achievable during Master's (extended) programmes if the learning takes place over time and provides 'reasonable' experience in aspects of research. For this to fit in with the clinical immersion learning experience, such projects should engage students with healthcare delivery.

The third was that a fairly high, but lower level of declarative knowledge (multi-structural and relational) is required pertaining to scientific methods, ethical and privacy principles, and these should be heavily grounded in application to the profession. This is consistent with the inclusion of research training modules in coursework, but without a requirement to complete a research project.

IV. DISCUSSION

Medical curricula should constantly evolve to meet the perceived needs of the changing population and health systems. Cooke et al. (2010) tell us that the virtues of being curious, of being open to further learning, taking time to consider different perspectives and weigh up the options are metacognitive skills that should be developed early in medical training to cultivate lifelong learning and drive for continuing improvement in health systems. The emphasis in current medical education commentary is to provide options and electives for flexible, student-led approaches to learning.

The AMC graduate outcomes (Australian Medical Council Limited, 2012) affirm that a critical component of developing competency as a doctor is the opportunity to hone generic skills such as communication and teamwork and apply developing knowledge through authentic experience in the clinical setting. Functional knowledge is demonstrated through project work conducted (ideally) in real work settings. This experience provides opportunities to learn to adapt to unforeseen medical problems and to learn interactive and reflective skills important in achieving both specialist professional performance and life-long learning. Fostering knowledge and skills in seeking information, considering alternatives, collaborating, making decisions, planning and executing the plan may better prepare medical professionals for leadership roles that are required of responsive health systems where emerging technology and global forces are likely to drive adaptation and reform. Facets of critical inquiry, such as recognising a knowledge gap, seeking information, seeing multiple perspectives, taking time to consider alternatives and then make a judgement, are also qualities of an adaptive leader. Achieving all of this through a completed research project during primary medical education is

challenging. Performing one component well may be enough if it is known how the component fits as part of the whole.

Specific requirements for knowledge and skills in research and their application are still inherent in both AQF and AMC standards. Expertise in defining a searchable question and finding and assessing the evidence are realistic and useful goals for primary medical training and are professionally relevant to the work of doctors in the 21st century. Conducting literature reviews about topics that matter to the local community can be achieved in primary training. There are models of collaboration within healthcare settings where medical students are supported in a community of practice with more senior doctors overseeing local quality improvement projects. Quality improvement projects in Primary Care offer further opportunity.

There may be other ways of achieving Master's level learning outcomes that do not require research experience, as some students are not ready for this. Examples include project work in professional and capstone settings, where students performed skills associated with developing leadership and management competency in a range of different contexts.

V. CONCLUSION

Achieving higher-order thinking by the end of primary medical education is emerging as crucial to graduating doctors who are better prepared for managing the future challenges of healthcare. Integration of research thinking with work-based experience may be the critical attribute to foster this and may also be achieved through professional and capstone projects. There is a case for providing stronger guidance on just what is intended and achievable within the constraints of contemporary medical education. It is unlikely that the move to Master's level programmes in Australia will on its own result in more research capable graduates; more important may be how students are introduced to research knowledge and practical experiences. However, adopting Master's level outcomes as the endpoint may improve consistency in achievement of higher-level thinking and the inferred ability to find solutions to challenges as healthcare evolves.

Notes on Contributors

Colleen Cheek developed the methodological framework for the study, performed data collection and data analysis as part her PhD research project, and wrote the manuscript, collated edits and approved the final manuscript.

Richard Hays reviewed the study design and interpretation and developed the manuscript, read and approved the final manuscript.

Janie Smith reviewed the design of the study and gave critical feedback to the writing of the manuscript, read and approved the final manuscript.

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Declaration of Interest

We have no conflict of interest to declare.

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*Colleen Cheek
ADON Education and Research,
Tasmania Health Service North West
PO Box 258, Burnie 7320
Email: Colleen.Cheek@ths.tas.gov.au

Appendix 1

Table 1
AQF Level 9(E) criteria and descriptors (AQF, 201) and AMC standards (AMC, 2012) and graduate outcomes pertaining to research knowledge and skills

	AQF criteria and descriptors specifically pertaining to research knowledge and skills
I	Have specialised knowledge for research and/or professional practice and/or further learning.
II	Have expert skills to analyse critically, reflect on and synthesise complex information, concepts and theories.
III	Have expert skills to research and apply established theories to a body of knowledge or practice.
IV	Have knowledge of research principles and methods applicable to the discipline and its professional practice.
V	Reflect critically on theory and professional practice.
VI	Have cognitive, technical and creative skills to: a. Investigate, analyse, and synthesise complex information, problems, concepts and theories, and to apply established theories to different bodies of knowledge or practice; b. Generate and evaluate complex ideas and concepts at an abstract level.
VII	Have communication and technical research skills to: a. Justify and interpret theoretical propositions, methodologies, conclusions and professional decisions to specialised and non-specialised audiences; b. Design, evaluate, implement, analyse and theorise about developments that contribute to professional practice.
VIII	Demonstrate application: a. With creativity and initiative to new situations; b. With high-level personal autonomy and accountability; c. To plan and execute a project.
	AMC Standards – Science and Scholarship
IX	Access, critically appraise, interpret and apply evidence from the medical and scientific literature;
X	Apply knowledge of common scientific methods to formulate relevant research questions and select applicable study designs;
XI	Demonstrate a commitment to excellence, evidence-based practice and the generation of new scientific knowledge.
	AMC graduate competencies
XII	Knowledge of scientific method relevant to medical practice;
XIII	An appreciation of the responsibility to contribute towards the generation of knowledge;
XIV	the ability to interpret medical evidence in a critical and scientific manner;
XV	the principles of ethics related to healthcare, communication skills and preparedness to work effectively in a team with other healthcare professionals

Appendix 2

Table 2
Information literacy required in AQF Level 9(E) degree (AQF, 2013) and AMC standards (AMC, 2012) and level of understanding using SOLO taxonomy (Biggs & Collis, 2014)

AQF criteria and descriptors; AMC standards; and AMC competencies	**Type of knowledge**		**Level of understanding indicated by the verb**
(I, II, III, IVa, VIa, VII, VIIIa,	Declarative	Where to find complex information	Multi-structural
VIIIb, VIIIc,);	Functional	Complex information, concepts and theories:	
(IX);		-Search	
(XIV);		-Investigate	Multi-structural
		-Critically analyse	Multi-structural
		-Synthesise	Extended abstract
		-Interpret	Relational
		-Apply	Relational
		-Reflect on	Relational
			Extended abstract
(I, II, III, V, VIa, VIb, VIIa, VIIb,	Declarative	Established theories	Multi-structural or Relational
VIIIa, VIIIb, VIIIc)	Functional	Established theories:	
		-Review	Multi-structural
		-Justify	Relational
		-Interpret	Relational
		-Apply	Relational
		-Reflect critically	Extended abstract
		-Generate ideas	Extended abstract
(I, III, IV, VIIa, VIIb);	Declarative	Have knowledge of:	
(X);		- research principles	Uni/multi-structural
(XII, XV).		- quantitative and qualitative research methods	Uni/multi-structural
		- common scientific methods & epidemiology	
		- ethical and privacy principles and approval processes	Multi-structural/ Relational
		- research process	Multi-structural
		- project management	Multi-structural
	Functional	Theoretical propositions:	
		- Interpret	Relational
		- Justify	Relational
		- Communicate	Multi-structural
		Research skills and knowledge:	
		- formulate research question	Relational
		- select applicable study design	Multi-structural
		Project management:	
		- Plan	Relational
		- Execute	Relational
		- Communication	Multi-structural
		- Teamwork	Relational